Title: State Fair Statistics

Brief Overview:

> This unit utilizes a simulation of State Fair activities to teach methods of data collection and record keeping. Students will learn graphing techniques including: pictograph, bar graph, tally sheet, outcome wheel, stem and leaf plot, and line plot.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*

- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*

- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*

- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*

- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*

- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standard**

  <u>**Data Analysis and Probability**</u>
- *Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them; collect data using observations, surveys, and experiments; and represent data using tables and graphs such as line plots, bar graphs, and line graphs.*
- *Select and use appropriate statistical methods to analyze data; describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed; use measures of center, focusing on the median, and understand what each does and does not indicate about the data set; and compare different representations of the same data and evaluate how well each representation shows important aspects of the data.*
- *Develop and evaluate inferences and predictions that are based on data; and propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.*
- *Understand and apply basic concepts of probability; describe events as likely or unlikely and discuss the degree of likelihood using such words as certain, equally likely, and impossible; predict the probability of outcomes of simple experiments and test the predictions; and understand that the measure of the likelihood of an event can be represented by a number from 0 to 1.*

- **Process Standards**

Problem Solving
- *Instructional programs from prekindergarten through grade 12 should enable all students to build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; and monitor and reflect on the process of mathematical problem solving.*

Communication
- *Instructional programs from prekindergarten through grade 12 should enable all students to organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; and use the language of mathematics to express mathematical ideas precisely.*

Connections
- *Instructional programs from prekindergarten through grade 12 should enable all students to recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in contexts outside of mathematics.*

Representation
- *Instructional programs from prekindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas.*

Links to National Science Education Standards:

- **Science as Inquiry**
  The students will make predictions/hypothesis, experiment to test these, and evaluate the outcomes during the Midway Games.

Grade/Level:

Grades 2-3

Duration/Length:

Four to five class days

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Basic number sense, one to one correspondence, and concept of ordinal numbers
- Basic addition and subtraction skills
- Basic measurement skills in either standard or metric measurement
- Basics of letter writing

Student Outcomes:

Students will:

- demonstrate understanding of the vocabulary related to probability: "impossible, unlikely, equally likely, likely, certain."
- utilize terms of the scientific investigation: "predict/hypothesize, collect, display, and analyze data, evaluate."
- employ data display methods, including pictograph, bar graph, tally sheet, outcome wheel, stem and leaf plot, and line plot.
- follow directions to create a headband.
- organize and discuss data.
- communicate findings both verbally and in written form.
- participate in activities cooperatively.

**Materials/Resources/Printed Materials:**

- Student and Teacher Resource Sheets
- Poster board or large paper
- Squares of paper
- Penny Pitch Board (see Teacher Resource #2) and pennies
- Leaf cut outs
- Duck Pond and color coded ducks
- 4-5 spinners, separately programmed
- Ziploc bags
- Sentence strips, scissors, glue
- horse head template (see Teacher Resource #3)
- Dice
- Award ribbons

Development/Procedures:

Day 1 - Introduction to Theme
Approximately 60 minutes

A. PLACE MAT/BRAINSTORMING
- **Warm Up**: In small groups (3 or 4 students), brainstorm what each child knows about a state fair. Use a large sheet of paper or poster board, divided as shown in the diagram below.   Have each child record his ideas in one of the outer sections (labeled A, B, C, D).
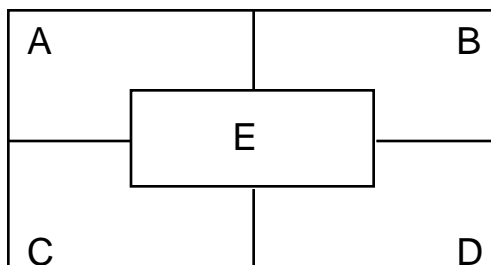
- Discuss "simulation" and have groups combine their ideas as to how a state fair could be simulated within the classroom. One student should write the combined ideas in the center rectangle of the place mat (labeled E) to report to the rest of the class.

- Discuss results of groups' brainstorming and incorporate ideas into the plans for the week.

B. FAVORITE ANIMAL PICTOGRAPH:
- Discuss animals found at a fair. Construct a graph template on the board. (See sample graph on Teacher Resource #1.)
- Distribute small squares of paper and ask child to illustrate his or her favorite farm animal.
- Display each child's illustration in the correct row of the graph. Discuss results.

C. STATE FAIR PROBABILITY PARADE:
- Discuss the terms: impossible, unlikely, equally likely, likely, and certain.
- Construct a probability scale on the floor using a long piece of ribbon or tape and cards with the above terms written on them.
- Distribute questionnaire (Student Resource #1) and have children check appropriate column.
- Ask volunteers to come forward and stand at appropriate point on the scale to show how they answered each question. Discuss differences of opinion.

Day 2 - Midway Day! (Simulation Stations)
Approximately 60 minutes
(Depending on your class, you may want to allow two days to complete these activities. It worked well to spend one day on the stations and one day on the follow-up activities.)

A. **Introduction:** Review discussion from previous day. Discuss the Midway of a fair. Review terms and introduce all of the simulation stations. Students will visit various simulation stations in small groups. There will be a recording sheet or something to make for each activity. After students have visited all stations, discuss activities and complete follow up activities as a class. (So that the follow up activities make more sense, we will describe them as we describe each simulation center.)
 Having a parent volunteer at each simulation station helps to facilitate the centers.

B. Station 1: Penny Pitch
- **Set up:** Cover the bottom of a large box (pizza box would work well) with colored squares or dish shapes (use paper plates if you like). Label each area with a numerical value (see Teacher Resource #2). You will need a supply of pennies at this station.

- **Game play:** In turn each child should pitch five pennies and record each value on Student Resource #2. The student should add all scores and record the sum for each set of 5.
- If time allows, each child may continue to take turns, recording all pitch scores and set totals.

- **Follow up:** Do with whole class group after all students have completed centers. Have students complete Student Resource 3a.
- As a class, plot the results (sums) on a stem and leaf plot. (Student Resource 3b is a template for a stem and leaf plot. Teacher Resource #3 is a sample.)
- Give each student a leaf cut out (die cuts or laminated note pad pages work well). Have students write the ones value from their best sum on their leaves. Place these on the board next the tens value that completes the number. Arrange numbers in numerical order to complete a graph.
- Have students copy the results onto their own graph (Student Resource 3b). Discuss and compare results. As a class, find the median (middle number) and the mode (most repeated). Discuss how these compare to the other numbers.

C. **Station 2: Duck Pond**
  - **Set up:** Teacher will need to provide either 25 duck shapes (laminated note pads or die cuts), yellow plastic cups with dots, or 25 plastic or rubber ducks to float in water. On the bottom of each you will need to place a sticky dot or mark with a water-proof marker if you plan to "float" your ducks.

    Mark the ducks following this guideline:
Red	2 ducks
Yellow	3 ducks
Green	5 ducks
Blue	5 ducks
Black	10 ducks

  - **Game play**: Distribute Student Resource #4 (Duck Pond Probability). Each child is to pick up 25 ducks, recording the color found on the bottom of each duck on his/her own tally sheet. Children will need to take turns so that not more than one duck is out of the pond at one time.

  - **Follow up:** Upon completion of the activity each group is to hypothesize the total number of each color they think there were. Have students write their predictions next to their data table. Have students complete a bar graph to display their data (Student Resource 4b). With whole class group, discuss the station and compare predictions as to the color distribution thought to be on the bottom of the ducks. Reveal actual distribution and discuss the discrepancies.

D. **Station 3: Farm Animal Winners Game**
  - **Set up:** Discuss how animals usually win awards at the State Fair. Explain that this game will turn that "winning of awards" into a game of chance by the spinning of a "wheel" (spinner). Make enough spinners (see Teacher Resource # 4) for each child at the center to have his/her own spinner, which should be different than that of all others being used at that time. Children should not necessarily be aware that each spinner is different. Give each child a copy of Student Resources #5 (Farm Animal Blue Ribbon Awards Tally Sheet) to record data

  - **Game play:** First have students record display on spinner next to pictures on tally sheet. Have students predict how many of each animal they will spin by looking at their spinners. Students should write their predictions in the first column of their Farm Animal Awards Tally Sheet (Student Resource #5). Using the numbers they wrote, they will fill in boxes on the inner circle of the Outcome Wheel (Student Resource #6). Students should write a C for each cow, a G for each goat, P for pigs, and R for rabbits. They should fill in all 16 boxes in a clockwise direction with one letter, starting at the Main Gate (darker line) and *staying in the same order as the chart* (group all cows, then goats, then pigs, then rabbits). So if the prediction is 5 cows, write C in the first 5 boxes. (*This will require adult guidance.*)
  - After recording all predictions, each child should spin their wheel 16 times, recording the "winners" on their tally sheets (Student Resource #5). After completing all 16 spins, the children should total up their rows of tally marks.

  - **Follow up**: Give students Student Resource #6 (Farm Animal Winners) and a ziploc bag of "animal chips" (Teacher Resource #5). Your may wish to reduce the animal chips when you copy them so that they fit into the outcome wheel better. I also enlarged the spinners before laminating them. Using the bag of precut animal "chips" they should place one for each animal spun, again beginning with the cows and starting at the Main Gate. These chips should be placed (and glued) into the outer circle found on Student Resource #6.

For each cow spun, one chip should be placed in the outer circle. Then place a chip for each goat spun, followed by the pigs, then the rabbits. For clarification see <u>Teacher Resource #6</u>.Discuss all the findings, especially Predictions vs. Outcomes. Have the children write four sentences reporting their findings on this activity.

E. **Station 4: Horse Hat Construction** (To be used for tomorrow's Horse Race Activity)
   • **Set up:** Provide each child with a sentence strip, scissors, glue, crayons or markers and a horse head pattern (<u>Teacher Resource #7</u>).

   • **Instructions**: Have each child make a hat by cutting out the horse pattern and folding back about one inch along the chest side. Glue fold to hat, matching bottom of horse head to bottom of sentence strip. Fit each strip to each child's head and staple. Be sure to write child's name inside each hat.
       If a time filler is needed at this station, children could read books about horses or horse racing, draw pictures of horses or write a story about a horse or horse race.

   • **Follow up**: We will wear our hats during our horse race!

F. Some other ideas (if you would like to add more stations)
   • Bean Bag Toss: Graph the distances away from the target or number of times target is hit.
   • Basketball shoot: Compare differences away from the basket and how it effects the number of shots, or using two different sized balls, or using right or left hands to shoot.
   • Bowling: Graph number of bottles/pins knocked over or compare use of different sized balls.
   • Design a glyph for your classmates.

Day 3 - A Day at the Races!
       Approximately 60 minutes

A. **Graphing Advantages - Comparing Narratives to Graphed Data**
   • Read "Foods at the Fair" (<u>Student Resource #7</u>) to entire class (if readability is an issue with your class--if not, skip this step).
   • Pass out "Foods at the Fair" (<u>Student Resource #7</u>) to about 3/4 of the class. Pass out "Foods Bought at the Fair" (<u>Student Resource #8</u>) to the remaining students. Don't let students see that the papers are different. Instruct students to keep papers face down until you ask the first question because they will be racing to find the answers.
   • Ask students questions from <u>Teacher Resource #8</u>, moving ahead pretty quickly as students answer questions.
   • Show students the pictograph that 1/4 of the students had. (You may wish to make as overhead of this.) Discuss the differences in the way the data was displayed and how the graph was useful and when graphs are useful. Also discuss the two questions that could not be answered using the graph (1 and 10).

B. **Horse Race!**
   • Assign students numbers 2-12. This will be the number for their horses. You may divide the class into groups and do two races or have students work together to be the horses. You will also need a record keeper and a dice roller (unless you just want those jobs).
   • Line up students. You should have a finish line marked as well. Students may take a step towards the finish line when their number is rolled (the sum of two dice). Discuss the best way to record the data from the race. Should we use a narrative or a line plot? Set up a place to record on the chalk board.
   • Start the race--roll until at least the top three horses have crossed the finish line (or you can set a number of times to roll the dice and just compare how far apart the horses are).
   • Discuss the data. (Was this a fair way to do a race? Why or why not?)

- As an extension, work out all of the possible combinations that could be rolled. Discuss how this affected the race.
- Students can copy the data from the race onto their own copy of the Race Record (Line Plot) (Teacher Resource #9) if you like.

- **Follow Up:** Students can write about the race and what they learned about probability in their math journals.

Day 4 - Write
Approximately 60 minutes

A. **Set Up:** Discuss all of the activities that the students have completed this week with the simulation of the State Fair. List student ideas on the board. Discuss activities that the students liked or disliked. Ask for other activities that students feel should have been included.

B. **Writing Assignment:** Students will write a letter to the MD State Fair. (Change this to fit your state.) Here is the address for the MD State Fair:
> F. Grove Miller (President and Chairman)
> MARYLAND STATE FAIR AND AGRICULTURAL SOCIETY, INC.
> P.O. Box 188
> Timonium, MD 21094-0188

- Students are to write to the MD State Fair to tell Mr. Miller about our school simulation.
  > Students should write about:
  - Favorite activities done during our simulation
  - What they have learned about probability and graphing
  - Ideas for new activities or things that should change about existing activities
  - Suggestions for next year's State Fair, based on our experiments.
- A Rubric is included for the letter (Teacher Resource #10).

Performance Assessment:

Assessment will be on-going, utilizing student work samples and classroom observations through this unit and continuing throughout the year. Many of these data collection and analysis techniques are being introduced, so mastery is not expected at this point. Rubrics are included in the Teacher Resources (#10 and 11) for use with the letter and with sentences written in response to other activities.

Extension/Follow Up:

For more information about the MD State Fair, contact msfair@msn.com or go to their web site: marylandstatefair.com.
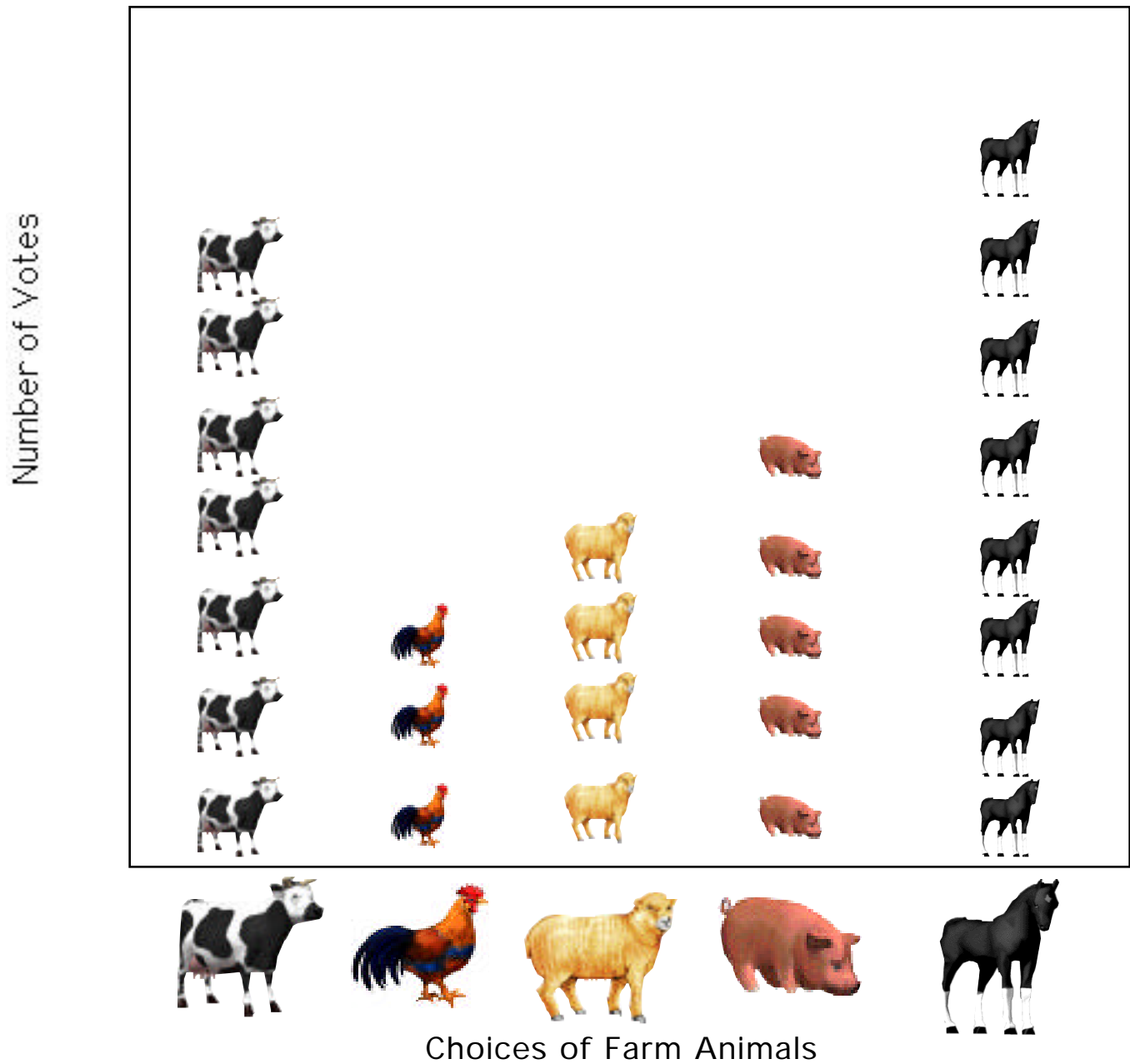
Authors:

Judy Dawson   Christie Tucci
St. James Academy   West Friendship Elementary School
Monkton, Maryland   Howard County, Maryland

(Sample Pictograph)

Favorite Farm Animals

Choices of Farm Animals

Key: One picture = one vote

Name: _____

State Fair Probability Parade

What are the chances?
Think about the following events. Decide how likely it is for each to occur at the fair. Make a check to show how likely you think it is.

How likely is it...?	Impossible	Unlikely	Even Chance	Likely	Certain	
1. You will see an animal.						
2. You will touch an animal.						
3. You will eat something.						
4. It will rain.						
5. You will see your teacher.						
6. It will snow.						
7. You will go on a ride.						
8. You will see someone you know.						
9. You will have fun.						
10. You will win a prize.						

Station Set Up Directions:

Penny Pitch

Cover the bottom of a large box (Pizza box would work well.) with colored squares or dish shapes. (Use paper plates if you like.) Label each area with a numerical value. Use two or three digit numerals, if appropriate. You will need a supply of pennies at this station. Each student will throw five pennies per turn.

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        4        7        2

     8        6        5

 Try Your Luck!  Pitch 5 pennies and add your scores.
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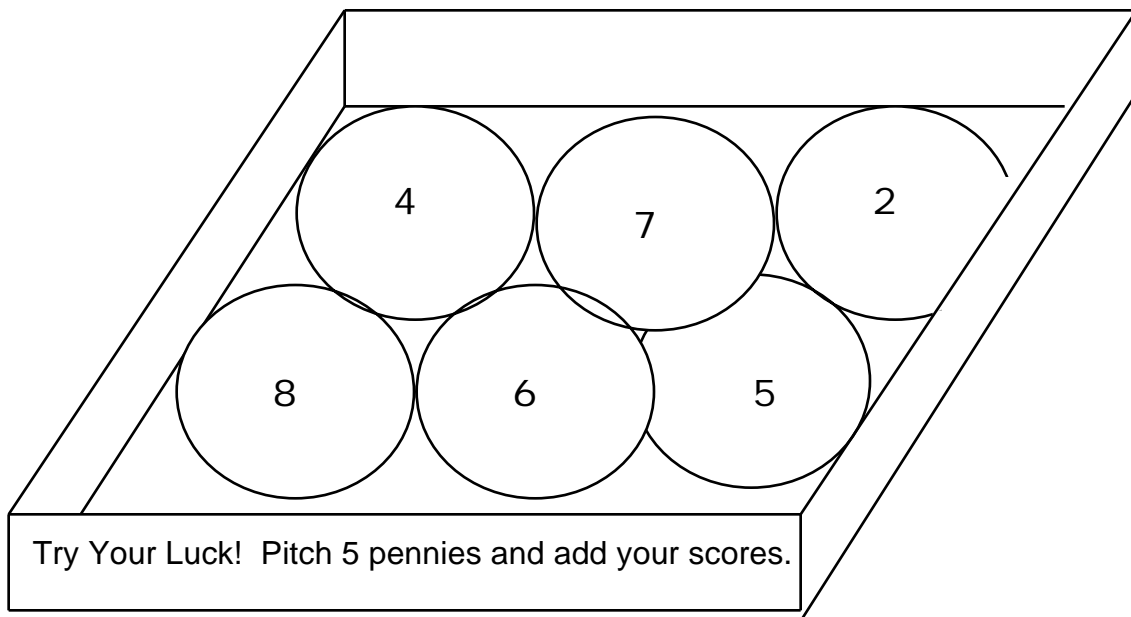
There is a student resource sheet for recording data on.

Name: _____

Station # 1: Penny Pitch

Record each pitch. Then add all five scores together. Record your sum.   Continue with other trials until time is up.

My Scores from Penny Pitch

	Try 1	Try 2	Try 3	Try 4	Try 5	Try 6
Pitch 1						
Pitch 2						
Pitch 3						
Pitch 4						
Pitch 5						
SUM						

Later today we will learn a way of plotting your results to see how your pitching skills compare with your classmates.

Name: _____

Today during our Midway Stations you played a penny pitch game. Take out your tally sheet now and circle your BEST score.

        My best score was: _____

Write one sentence to explain why this was your best score.
(Hint: Use greater than or less than).

_____

_____

_____

 Listen for directions. As a class we will create a Stem and Leaf Plot. Copy the Stem and Leaf Plot when we are done.

Stem and Leaf Plot

_____
(Title)
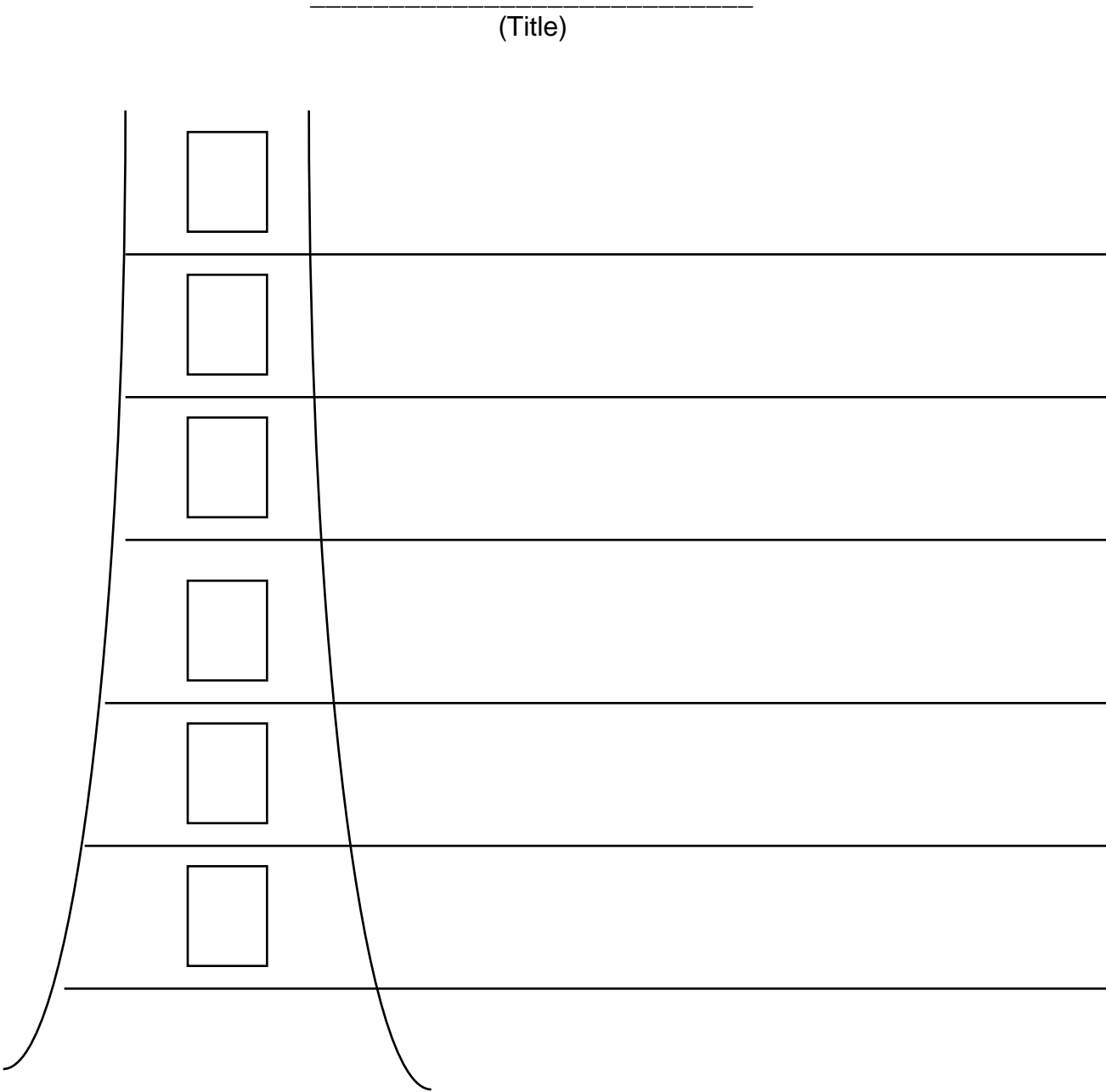
Key:

On the back, write three sentences telling about this graph.

(Stem and Leaf Plot Sample)

The Sum of Our Penny Pitch Scores

Stem	Leaf
0	0 0 5 7 8 9
1	0 0 1 4 6 7 8
2	0 1 1 1 1 4 4 6
3	0 3 4 5
4	
5	
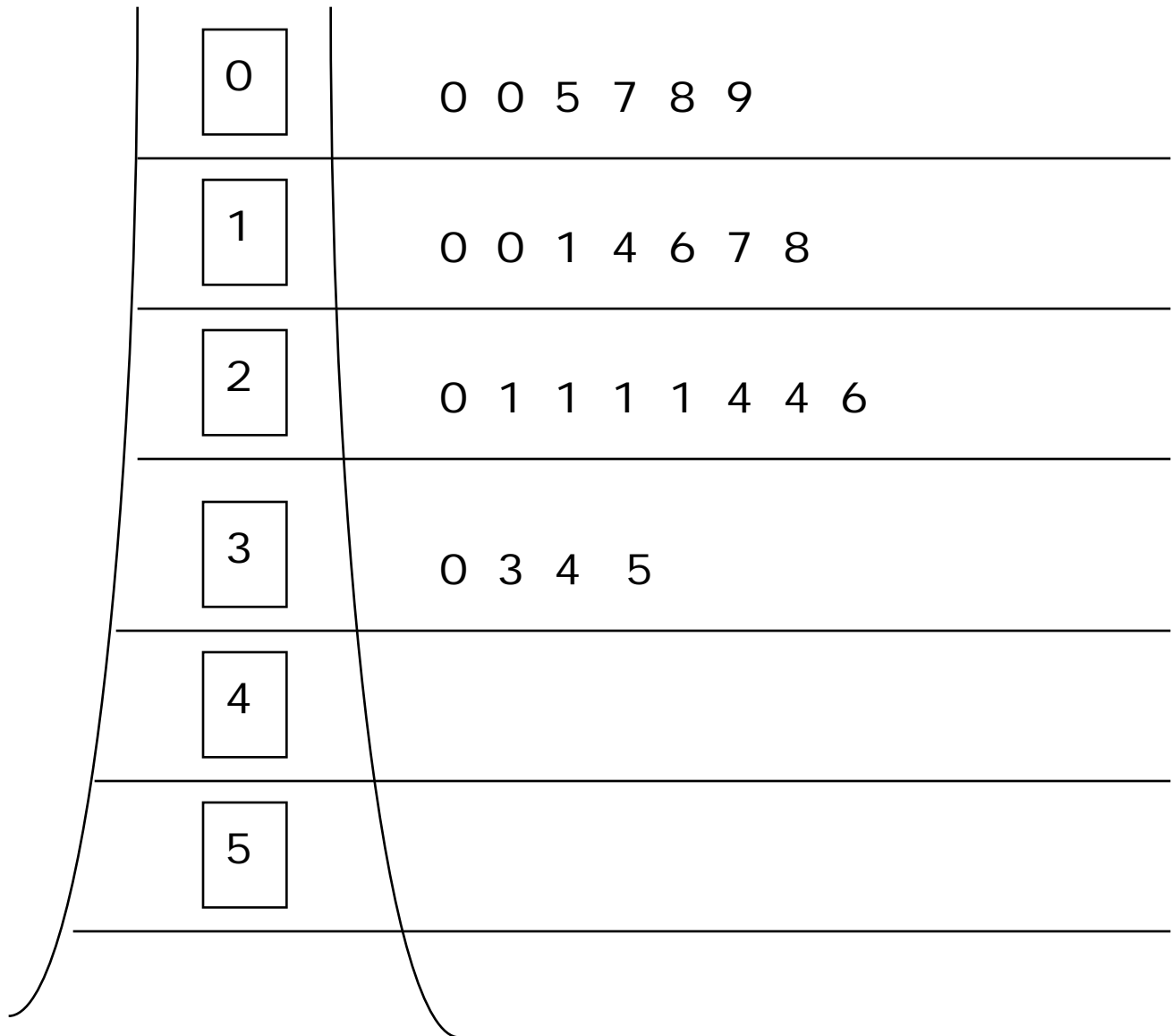
This is using the following data set: 0, 0, 5, 7, 8, 9, 10, 10, 11, 14, 16, 17, 18, 20, 21, 21, 21, 21, 24, 24, 26, 30, 33, 34, 35. On a stem and leaf plot, you list the value from the tens place down the side column and the values from the ones place in the corresponding row. The numbers should be placed in numerical order in the rows.

Key: 0   0 = 0 points

Name: _____

Duck Pond Probability

Welcome to the Duck Pond! The ducks in this pond all have beautiful colors on their stomachs. You are each to pick 25 ducks, one at a time. Keep track of the colors chosen by marking tally marks on the chart below.

After you have recorded the color, place each duck back with his friends in the pond. Take turns picking up only one duck at a time. We will use this data later.

	Tally
Red	
Yellow	
Green	
Blue	
Black	

Name: _____

Farm Animal Blue Ribbon Awards Tally Sheet

You will decide how many ribbons each animal will win!
1. Choose a spinner and look at the choices on it.
2. Predict how many ribbons you think each animal will win if you spin it 16 times.
3. Start awarding ribbons! Spin 16 times, keep a tally of the winners below.

	Predictions	Tally of Ribbons Won	Total Won
COW			
GOAT			
PIG			
RABBIT			

Write a sentence or two telling about your data.

_____

_____

Spinners   Teacher Resource #4
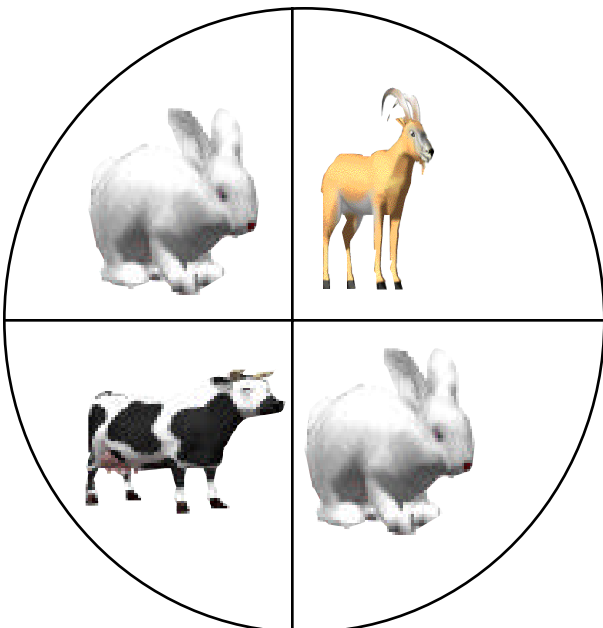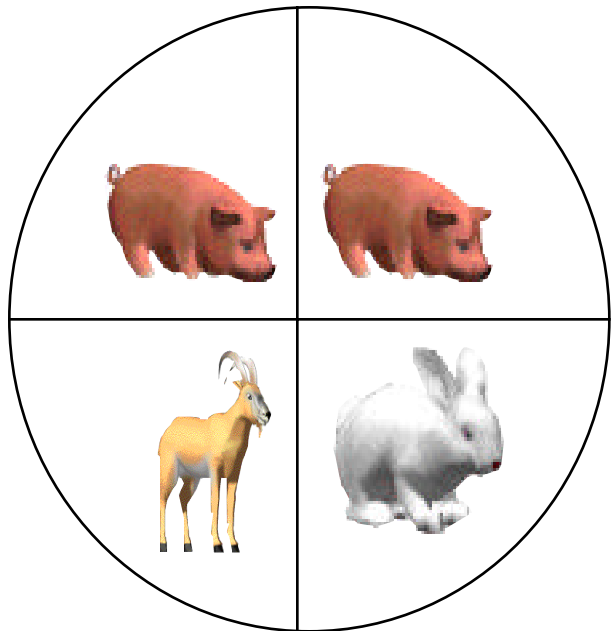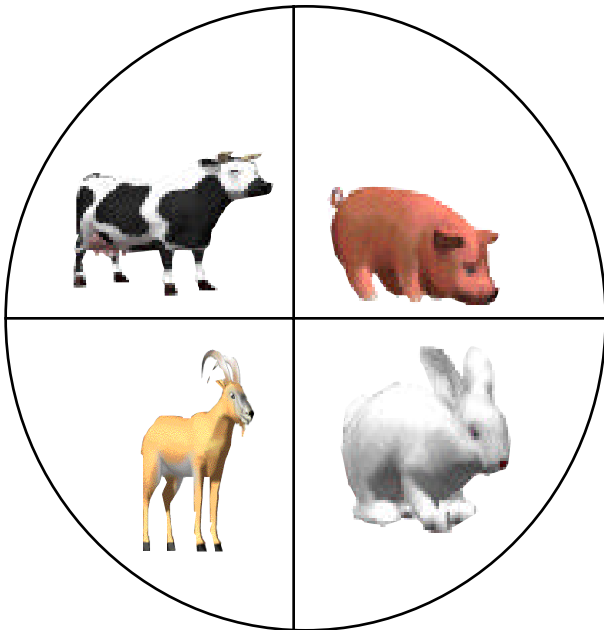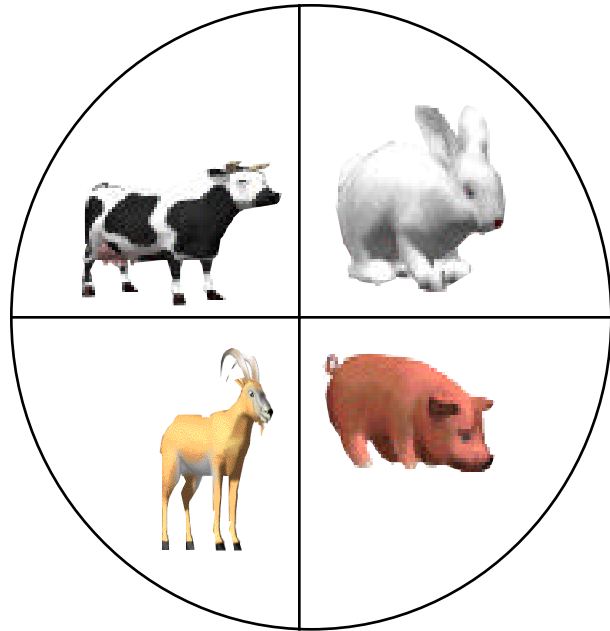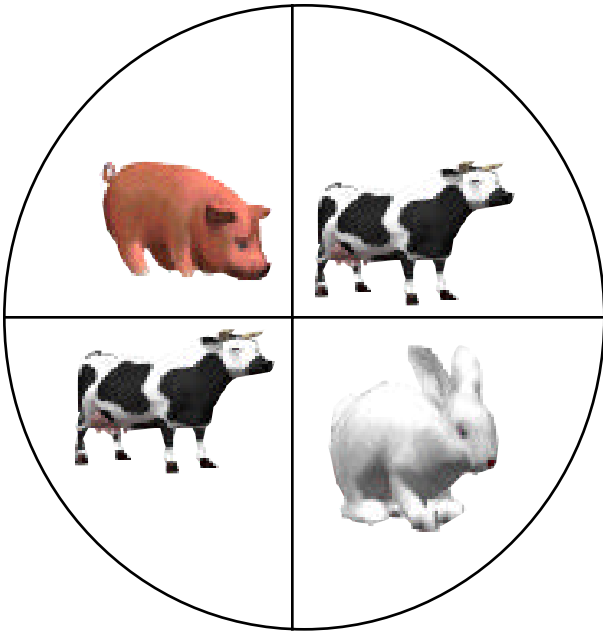
Main Gate

FARM ANIMAL
WINNERS
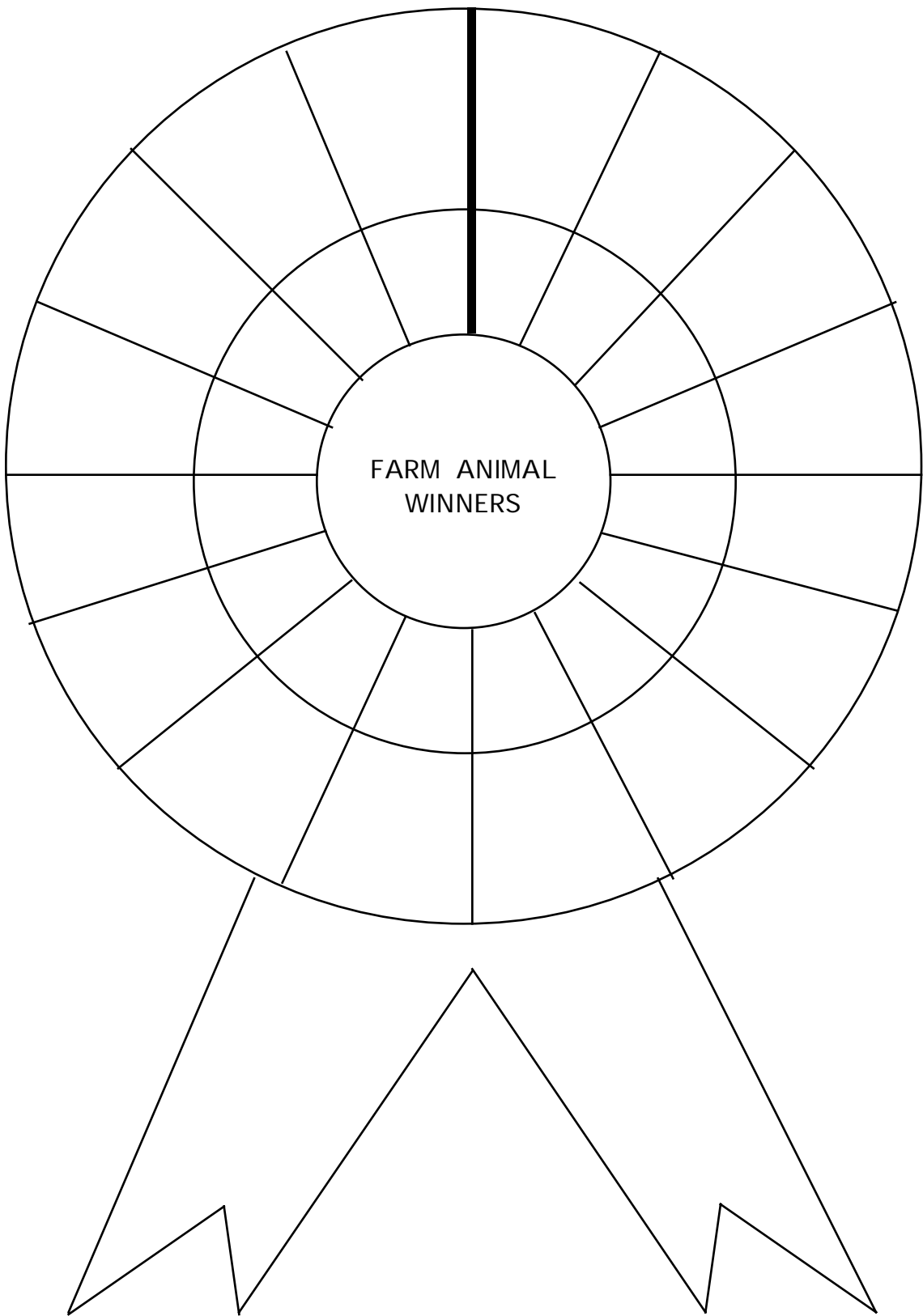
ANIMAL CHIPS - cut apart and put in bags for students to glue onto Farm Animal Winners' Wheel. They will glue the number of animals to show what they actually spin.

Sample of Completed Outcome Wheel

Predictions are written along inner wheel. Animal chips are glued along outside circle to show the actual results. Animals should be kept in same order as the tally chart.

Main Gate

FARM ANIMAL WINNERS

Inner wheel labels (clockwise from Main Gate): R, C, C, C, C, G, G, G, G, P, P, P, P, R, R, R
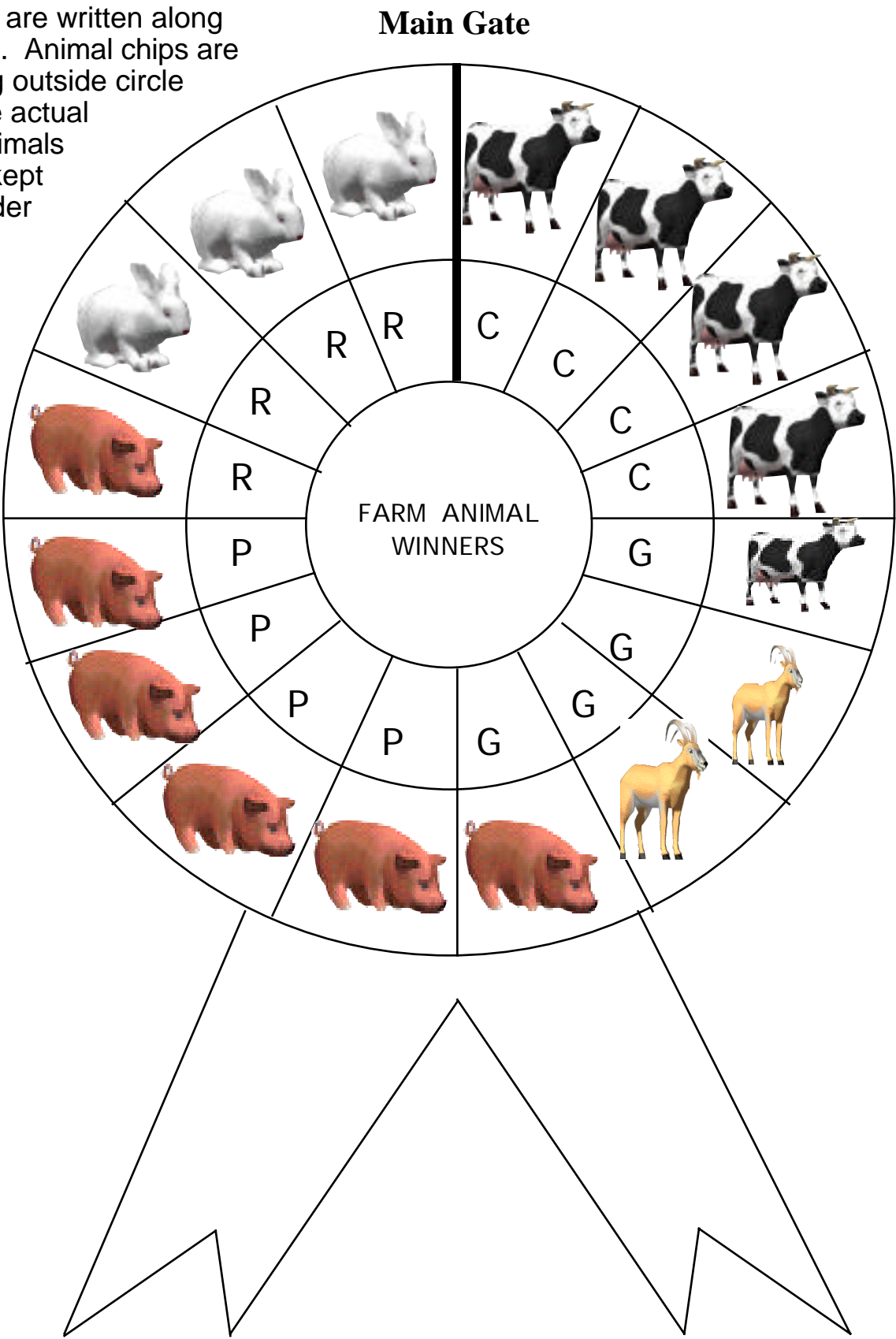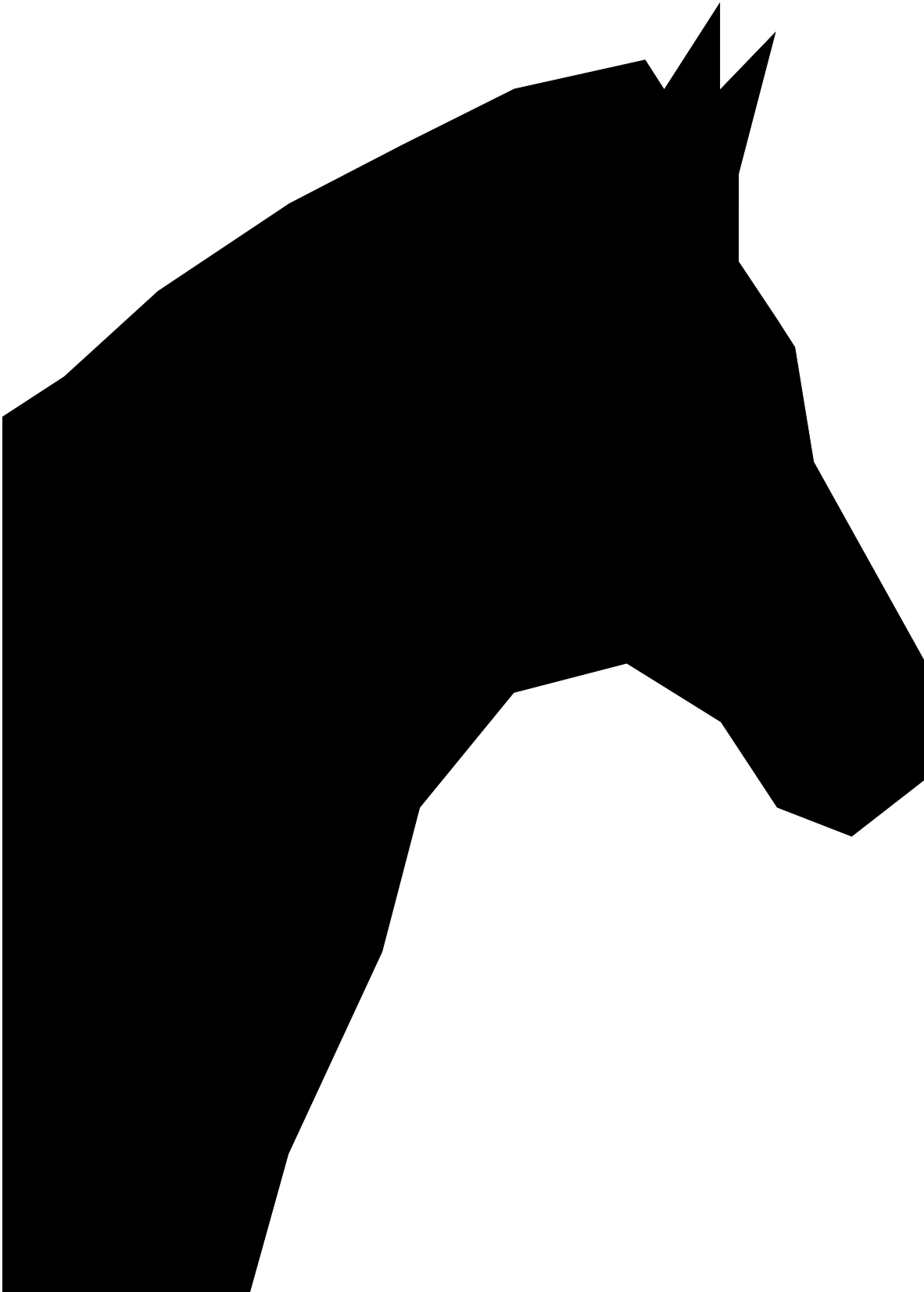
FOODS AT THE FAIR

The Brady family went to the State Fair last Saturday. Mom, Dad, and Alice, their housekeeper, took Greg, Marcia, Peter, Jan, Bobby, and Cindy. They were all hungry when they arrived, so they had lunch. Mom, Dad, and Alice had steak sandwiches. Peter and Jan each had a hamburger. Marcia and Cindy had corn dogs. Greg was going to have a hot dog, but he decided on a steak sandwich. Bobby had a hard time deciding, but finally chose a corn dog. Everyone decided they wanted a lemonade, but then those ordering corn dogs changed their mind and ordered sodas. All the men decided they wanted an ear of corn. For dessert all the girls had sno-cones. Dad and Peter bought ice cream. Bobby and Greg bought cotton candy. After everyone had filled up on Fair Food, they all headed off to the racetrack to watch a few races.

FOODS BOUGHT AT THE FAIR

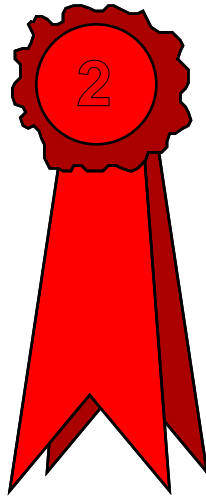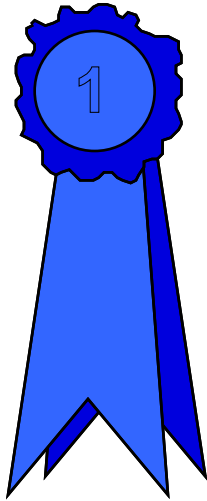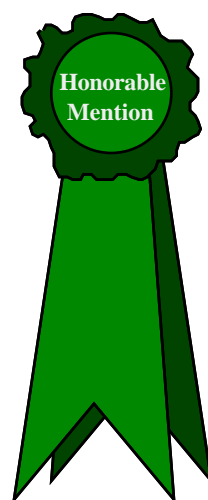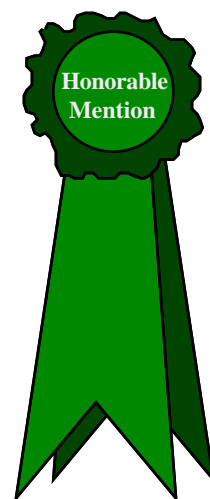|			X				
			X		X		
		X	X		X		
X		X	X	X	X		X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
Corn Dogs	Hamburgers	Steak Sandwich	Lemonade	Soda	Sno-Cone	Ice Cream	Cotton Candy

Food Choices

X= one serving

Questions to ask the class after distributing Student Resource Sheet #5 to 3/4 of the class and Student Resource #6 to 1/4 of the class:

1. How many of the Brady household went to the State Fair?

2. How many people had steak sandwiches?

3. How many people had corn dogs?

4. How many hamburgers did they buy?

5. How many lemonades did they order?

6. How many sodas did they buy?

7. How many sno-cones did they order?

8. How many ice creams did they want?

9. How many cotton candies did they buy?

10. What did the Bradys do after lunch?

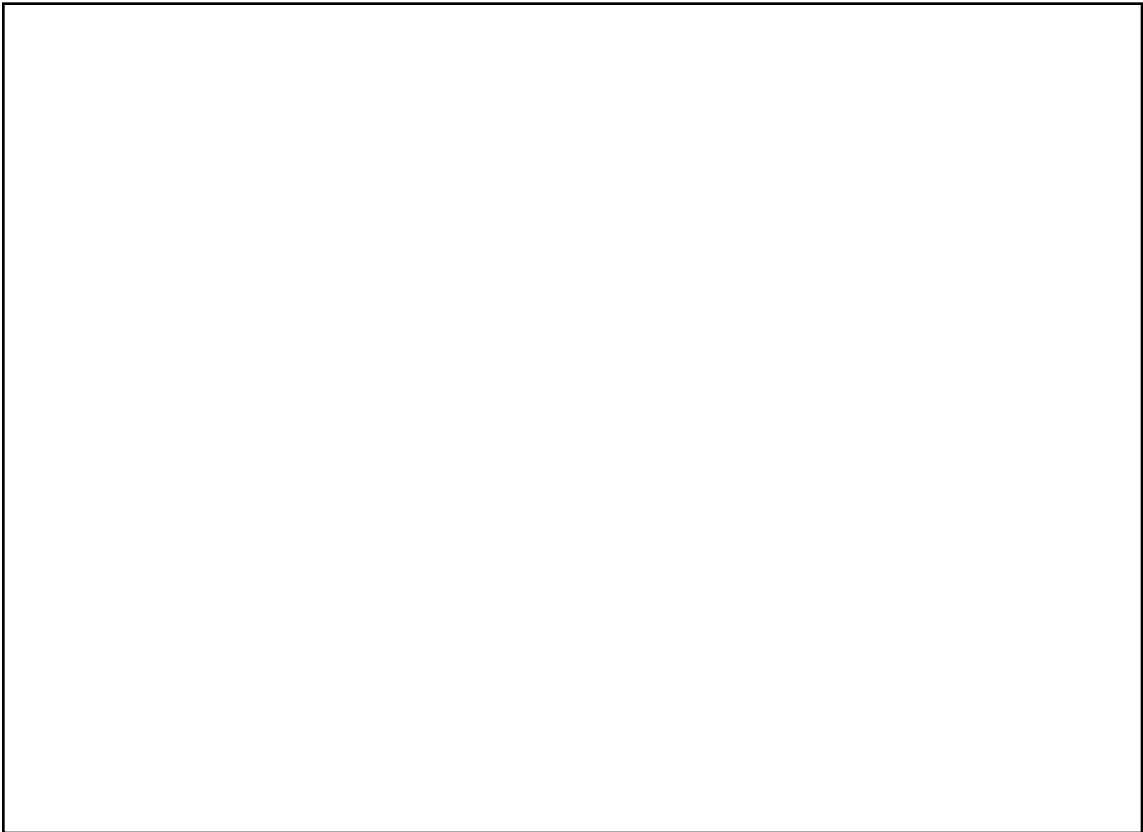**Award Ribbons for Horse Show**

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention

Honorable Mention
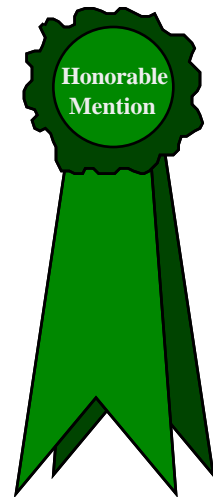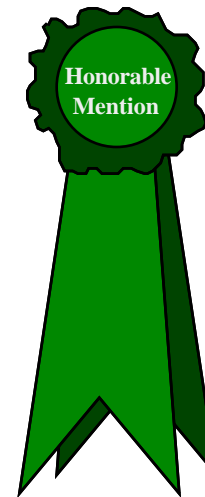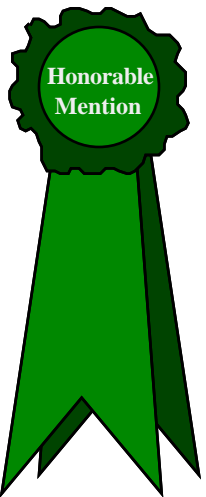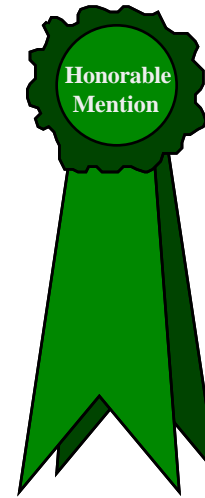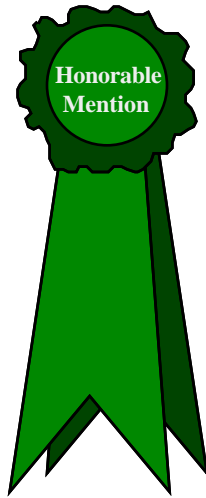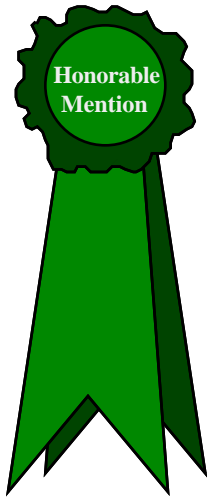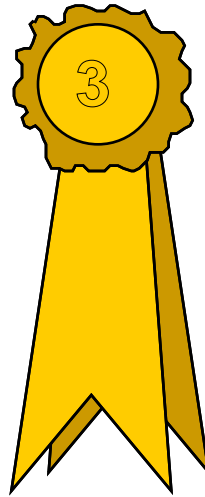
Results of the Horse Race

1	2	3	4	5	6	7	8	9	10	11	12

Number of Horse

X= one step towards
finish line

Scoring Rubric for Letter

3 - Correct letter format used.
Explanation of our simulation and about how probability was used.
Tells at least 3 activities liked or that need to change.
Shows that data was understood.
Used several Math key words
(such as: impossible, unlikely, likely, certain, predict, data)
No errors in capitalization, punctuation, or spelling.

2 - Letter format used.
Explanation of our simulation and how probability was used.
Tells 2 activities liked or that need to change.
Shows that data was understood.
Used few math key words.
Few errors in capitalization, punctuation, or spelling.

1 - Letter format used.
No explanation of simulation or of probability.
Tells one activity liked or that needs to change.
No use of math key words.
Several errors in capitalization, punctuation, or spelling.

Math Writing Rubric
(This can be used with any writing done in math.)

3   Student will clearly answer the question using supporting evidence and math terminology in a clear and concise manner.

2   Student will answer the question with some supporting evidence and some terminology.

1   Student does not cite supporting evidence or is unable to communicate understanding.

Self-Assessment for Writing

1. I capitalized all the beginnings of my sentences.

   ☺　　☹ ▯

2. I used the correct punctuation at the end of my sentences.

   ☺　　☹ ▯

3. I made complete sentences.

   ☺　　☹ ▯

4. I have included three supporting details.

   ☺　　☹ ▯

5. I have completed all of the parts of a friendly letter.

   ☺　　☹ ▯

6. I have used math key words when I can.

   ☺　　☹ ▯